

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference O.Z. 6223-WO | FOR FURTHER ACTION See Form PCT/PEA/416 | |
| International application No. PCT/EP2004/050989 | International filing date (day/month/year) 02.06.2004 | Priority date (day/month/year) 03.07.2003 |
| International Patent Classification (IPC) or national classification and IPC H01L21/312 | | |
| Applicant DEGUSSA AG et al | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (<i>sent to the applicant and to the International Bureau</i>) a total of 3 sheets, as follows:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. <p>b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | |
| <p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Box No. I Basis of the opinion <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or Industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application | | |
| Date of submission of the demand 06.11.2004 | Date of completion of this report 10.10.2005 | |
| Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Pusch, C Telephone No. +49 89 2399-7023 | |



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2004/050989

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-11 as originally filed

Claims, Numbers

1-11 received on 21.12.2004 with letter of 15.12.2004

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. The amendments have resulted in the cancellation of:
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):
4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|------|--------|-------|
| Novelty (N) | Yes: | Claims | 1-9 |
| | No: | Claims | 10,11 |
| Inventive step (IS) | Yes: | Claims | 1-9 |
| | No: | Claims | 10,11 |
| Industrial applicability (IA) | Yes: | Claims | 1-11 |
| | No: | Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1.0 Reference is made to the following documents:

- D1: Q. R. Huang et al., Chem. Mater. (2002) vol. 14, pg. 3676 - 3685
- D2: US4349609 (14.09.1982)
- D3: Q. Pan, Thin Solid Films, vol. 345, no. 2, 21 May 1999, pg. 244 - 254
- D4: US5152834 (6.10.1992)
- D5: EP1003210 (24.05.2000)

2.0 A process for producing low-k dielectric films on semiconductors or electrical circuits, which comprises using incompletely condensed polyhedral oligomeric silsesquioxanes of the formula $[(R_aX_bSiO_{1.5})_m(R_cY_dSiO)_n]$ with the structure 1 or 2 as the starting material (see point 3.1 below) is not known from or rendered obvious from any of the cited documents of the prior art. Each of the documents is concerned with low-k dielectric films made from silsesquioxanes and the method of their formation:

- D1 fig. 1;
- D2 Example 1 "ladder-type" polysilsesquioxane;
- D3 p. 245, col. 1, l. 35 - 52 and col. 2, last two lines: cage-like β -chloroethyl-silsesquioxane (BSCESSQ);
- D4 unspecific cage-like polyorganosilsesquioxanes;
- D5 paragraphs [0017] and [0018]).

The subject-matter of claim 1 is therefore considered to be new and inventive (Articles 33(1), 33(2), 33(3) PCT).

- 2.1 Dependent method claims 2 - 9 also fulfill the requirements of novelty and inventive step.**
- 2.3 Independent claim 10 is not allowable. It is attempted in claim 10 to define a product**

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(film) by the way of its formation. However, a product should be defined by product features which are directly discernable in the finished product and which render the product new and inventive over similar known products. (see WIPO Guidelines Chapter 5.26)

A low-k dielectric film is known (see any of the documents D1 - D5), and hence the subject-matter of claim 10 lacks novelty.

Including the feature of a value of the low-k constant of less than or equal to 2.3 as done in claim 11 would clarify claim 10 but does not render its subject-matter new, because such films are known from e.g. D1, p. 3682, col. 2, l. 30 - 42.

Re Item VIII

Clarity (Article 6 PCT)

- 3.1 It is clearly stated in lines 9 - 11 on page 8 or in the example on page 9 - 11 that the incompletely condensed polyhedral oligomeric silsesquioxane is used as "starting material" for the film and is not an intermediate product during film formation. It cannot be excluded that the "incompletely condensed polyhedral oligomeric silsesquioxane" of claim 1 is formed at some point from any precursor during film formation. In order to avoid misunderstanding the claim, "starting material" should be included in the independent claim.
- 3.2 Claim 6 cannot depend on claims 1 - 4, because no coreactant is mentioned in these claims.
- 3.3 Claim 10 lacks conciseness. It is referred back to 9 method claims in this claim. It is unclear which particular feature -if it was discernable in the finished film- of which of the nine claims is meant to limit the scope of claim 10.

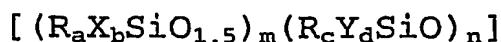
21.12.2004

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(106)

What is claimed is:

1. A process for producing low-k dielectric films on semiconductors or electrical circuits, which comprises using
 5 incompletely condensed polyhedral oligomeric silsesquioxanes of the formula



10 with:

a, b = 0-1; c, d = 1; m+n ≥ 3; a+b = 1; n, m ≥ 1,

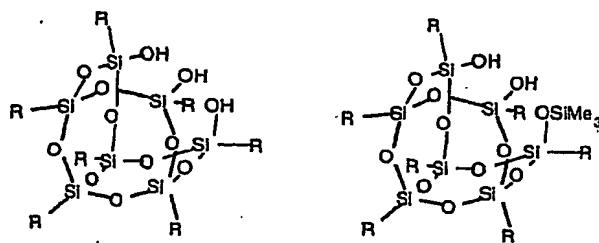
R = hydrogen atom or alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, cycloalkynyl, aryl or heteroaryl group, in each case substituted or unsubstituted,

15 X = an oxy, hydroxyl, alkoxy, carboxyl, silyl, silyloxy, halogen, epoxy, ester, fluoroalkyl, isocyanate, acrylate, methacrylate, nitrile, amino or phosphine group or substituents of type R containing at least one such group of type X,

20 Y = hydroxyl, alkoxy or a substituent of type O-SiZ₁Z₂Z₃, where Z₁, Z₂ and Z₃ are fluoralkyl, alkoxy, silyloxy, epoxy, ester, acrylate, methacrylate or a nitrile group or substituents of type R and are identical or different,

25 not only the substituents of type R being identical or different but also the substituents of type X and Y in each case being identical or different, and comprising at least one hydroxyl group as substituent of type Y, for producing the film and wherein incompletely condensed polyhedral oligomeric silsesquioxanes of structure 1 or 2

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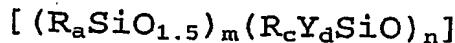


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2

are used.

5 2. The process as claimed in claim 1, wherein incompletely condensed polyhedral oligomeric silsesquioxanes of the formula



10 with:

a, c, d = 1; m+n ≥ 3; n, m ≥ 1,

R = hydrogen atom or alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, cycloalkynyl, aryl or heteroaryl group, in each case substituted or unsubstituted,

15 Y = hydroxyl, alkoxy or a substituent of type O-SiZ₁Z₂Z₃, where Z₁, Z₂ and Z₃ are fluoroalkyl, alkoxy, silyloxy, epoxy, ester, acrylate, methacrylate or a nitrile group or substituents of type R and are identical or different,

20 not only the substituents of type R being identical or different but also the substituents of type Y in each case being identical or different, and comprising at least one hydroxyl group as substituent of type Y, are used.

25 3. The process as claimed in claim 1 or 2, wherein incompletely condensed polyhedral oligomeric silsesquioxanes containing not more than three hydroxyl groups as type Y substituent are used.

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4. The process as claimed in at least one of claims 1 to 3, wherein incompletely condensed polyhedral oligomeric silsesquioxanes are reacted with alkoxy silanes.
5. The process as claimed in claim 4, wherein incompletely condensed polyhedral oligomeric silsesquioxanes are reacted with tetraalkoxy silanes.
10. The process as claimed in at least one of claims 1 to 5, wherein the molar ratio of the incompletely condensed polyhedral oligomeric silsesquioxanes to the coreactant capable of hydrolytic condensation is from 1:10 to 10:1.
15. The process as claimed in claim 6, wherein the molar ratio of the incompletely condensed polyhedral oligomeric silsesquioxanes to the coreactant capable of hydrolytic condensation is 2:1.
20. The process as claimed in at least one of claims 1 to 7, wherein the low-k dielectric film is produced by means of a wet-chemical coating method.
25. The process as claimed in claim 8, wherein the low-k dielectric film is produced by spin coating and subsequent calcining.
10. A low-k dielectric film produced as claimed in at least one of claims 1 to 9.
30. 11. The low-k dielectric film as claimed in claim 10, which has a k value of less than or equal to 2.3, measured at a frequency of 880 kHz.